A Significant Reduction in Air Kerma with a Simple Radiation Quality Initiative

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Background:
Minimizing exposure to ionizing radiation in the cardiac catheterization laboratory reduces the risk of both deterministic and stochastic injury to patients as well as cath lab personnel (1). We hypothesize that a Radiation Quality Improvement (RQI) program of education and feedback could modify operator behavior to decrease radiation use.

Methods:
We organized a single center quality improvement registry which collected air kerma and fluoroscopic time for all consecutive coronary diagnostic and interventional procedures in patients over age 18 years for all catheterization laboratory operators at the University of Vermont. There are three catheterization laboratories at UVM, all using current generation Philips Allura Xper fluoroscopy equipment. The baseline period was all cases between March 1 and June 30, 2010. The follow-up period was September 1, 2010 to February 28, 2011.

The Radiation Quality Improvement Initiative
The intervention with the aim of impacting radiation use occurred from July 1 to August 30, 2010. A faculty “champion” was designated (PG). The initiative consisted of training of all staff and operators specifically in regards to radiation use mitigation, including using low intensity fluoroscopic settings, minimizing use of cineography and improving imaging intensifier positioning with regards to c-arm angulation and source-image distance. There were two brief group feedback sessions (Figures 1 and 2). Additionally, the designated faculty champion would perform one-on-one feedback with operators. Cases that exceeded 6 Gy were individually reviewed and discussed at feedback sessions with all operators (Figure 3). Ten weekly “radiation safety tips” e-mails were sent (Figure 4) near the end of the RQI and continued in regular rotation.

Results:
2,093 patients underwent catheterization procedures during the registry period. 1,838 patients with complete data were included in this analysis. There was no change in the operators during the registry. Pre-RQI (N=704) and post-RQI (N=1,134) patients had similar clinical indications, clinical characteristics and level of urgency (Table 1). Fluoroscopy time per case was similar pre and post RQI (figure 5). There was a significant decrease in the average air kerma per case (1652±116 mGy vs. 1515±78 mGy, p=0.047, figure 6). There was heterogeneity in the response to our intervention amongst the operators (p<0.001 for the interaction). Besides the operator’s fluoroscopic behavior (p<0.001), and similar to other recent studies regarding predictors of radiation use (2), we found that certain unmodifiable variables have a significant effect on radiation use. Patient size (p=0.001) and age (p=0.001) were independently correlated with higher utilization of radiation.

Conclusions:
1. Operator behavior is an independent predictor of the use of radiation as measured by air kerma. It is the only modifiable predictor.
2. Our RQI, consisting of physician/staff education and rapid individualized feedback, is a feasible way to modify the use of radiation and decrease exposure to both patients and catheterization laboratory personnel.
3. Air kerma is a more accurate measure of radiation use compared to fluoroscopic time, as it takes into account patient size, time of cineography, fluoroscopy mode and C-arm angles. Air kerma also appears to be more amenable to education on the minimization of radiation use.

References